J Material Sci Eng 2013, 2:4
http://dx.doi.org/10.4172/2169-0022.S1.012

OMICS Group Conferences
Accelerating Scientific Discovery

2nd International Conference and Exhibition on
Materials Science & Engineering

October 07-09, 2013 Hampton Inn Tropicana, Las Vegas, NV, USA

Development of a novel tri-composite scaffold for Bone Regeneration

Bilal Aslam[1], Susan Clarke[2] and Helena McMahon[1]
[1]Institute of Technology Tralee, Ireland
[2]Queens University Belfast, Northern Ireland

Bone injuries and defects present a significant clinical problem, in order for these injuries to heal both bone regeneration and restoration of blood flow is required with the current gold standard of treatment involving invasive surgeries frequently associated with compilations and failures [1]. Consequently, the requirement for new bone tissue to restore the function of damaged or lost bone is a major clinical need. The project aims to develop a tri-composite biomimetic scaffold consisting of chitosan, fucoidan and hydroxyapatite for bone repair. Chitosan a natural cationic polymer with structural similarities to hyaluronic acid of the ECM is extensively applied in bone tissue engineering and has been shown to be osteogenic [2]. Fucoidan a sulphated polyfucose polysaccharide mimics the biological activities of heparin with the capacity to both sequester and potentiate the activities of the Fibroblast Growth Factors involved in tissue repair and angiogenesis [3]. Furthermore, fucoidan has been reported to promote osteogenic differentiation [4]. Hydroxyapatite (HA) the mineral component of bone is extensively applied in bone bioengineering with clear evidence that the HA inclusion in scaffolds promotes bone formation [5]. Based upon the above discussed properties of each component, there is clear evidence supporting the application of the tri-composite as a potential biomaterial for bone regeneration. There has been a significant research on the application of Chitosan as a biomaterial for biomedical applications such as tissue engineering scaffolds, drug delivery, wound dressings and antibacterial coatings. The application of hydroxyapatite for the promotion of bone regeneration is well documented with initial reports detailing the capacity of fucoidan to induce osteogenic differentiation of mesenchymal stem cells. However the application of all three materials as a tri-composite bio-material for bone regeneration has not been reported.

The first phase of investigations are currently in progress, the biocompatibility and osteo-inductivity of each of the materials selected for the tri-composite are currently being evaluated using a human fetal-osteoblast (hFOB1.19) cell model and Human Bone marrow derived Mesenchymal Stem cells (hbMSCs). Osteogenic differentiation and detection methodologies optimised and the osteogenic potential of the cells validated, utilising alkaline-phosphatase and Alizarin-Red analysis. In case of hbMSCs Osteogenic and Adipogenic differentiation potential is validated by using Alkaline Phosphatase, Alizarin red and Oil red O Staining Respectively. Chitosan from crab shells (Sigma) has been purified and tested with wide range of techniques for pH neutralization and to make membrane suitable for cell growth. The principal matrix material consisted of Chitosan is successfully developed and tested for Cytotoxicity. The Cytotoxicity and dose response of Fucoidan and Hydroxyapatite has already been evaluated individually across a various range of concentration. Fucoidan with concentration range between 25µg/ml to 6.25 µg/ml has showed increased cell growth as compared to the control. On the other hand, hydroxyapatite with concentration range of 200µg/ml has showed increased cell proliferation as compared to the control. The combination studies by combining both Fucoidan and Hydroxyapatite have also been conducted, Fucoidan:Hydroxypatite 12.5µg/ml:200µg/ml (1:1) has showed increased proliferation and thus, selected for evaluating the stem cells differential potential. In developing the tri-composite, the optimum ratios of each component required for effective osteo-induction will be determined; this information will contribute significantly to knowledge on the application of marine derived biomaterials for bone regeneration and bio-engineering.

Biography

Bilal Aslam has received his Degree in Biotechnology from the Waterford Institute of Technology (WIT) Ireland and completed his BSc (H) in Applied Biology with Quality Management, also at WIT. Bilal has previously worked as a Research Assistant at the centre of Micro-electronics Application Integration in Tyndall National Institute, University College Cork, Ireland and has brought his skills in biocompatibility studies, surface characterisation, surface modification, biomaterials for tissue engineering, biomarkers for *in-vivo* infection, biosensors and diagnostic devices to Shannon Applied Biotechnology Centre, where he is currently working as a Post- Graduate researcher on evaluation of chitosan: fucoidan: Hydroxyapatite tri composite Biomaterial for bone regeneration.

bilal.aslam@research.ittralee.ie